

①

ACP Chem. 1st Semester Final Exam 2016 KEY

1. $P_1 V_1 = P_2 V_2$
 $P_1 = \cancel{3.33} \text{ atm}$ 2.23 atm
 $V_1 = 3.33 \text{ L}$
 $P_2 = 2.50 \text{ atm}$
 $V_2 = ?$

$$V_2 = \frac{P_1 V_1}{P_2} = \frac{(2.33 \text{ atm})(3.33 \text{ L})}{(2.50 \text{ atm})} = 2.97 \text{ L} \quad \text{C}$$

2. $PV = nRT$
 $P = \frac{nRT}{V} = \frac{(0.127 \text{ mol} + 0.288 \text{ mol})(0.08205 \frac{\text{L-atm}}{\text{mol-K}})(20+273 \text{ K})}{6.00 \text{ L}}$
 $= 1.66 \text{ atm} \quad \text{D}$

3. $PV = nRT$
 $n = \frac{g}{M}, d = \frac{g}{V}$
 $PV = \frac{gRT}{M}, \frac{g}{V} = \frac{PM}{RT}, \frac{P}{RT} = \frac{0.987 \text{ atm}}{(0.08205 \frac{\text{L-atm}}{\text{mol-K}})(273+7 \text{ K})}$
 $= 0.0401$
 $\frac{1.37 \text{ g/L}}{0.0401} = x = 34.16 \text{ g/mol} \quad \text{C}$

4. $\frac{V_1}{T_1} = \frac{V_2}{T_2}, \quad V_2 = V_1 \times \frac{T_2}{T_1} = 10.0 \text{ L} \times \frac{394}{298}$
 $= 13.2 \text{ L} \quad \text{C}$
 $V_1 = 10.0 \text{ L}$
 $T_1 = 25 + 273 \text{ K} = 298 \text{ K}$
 $V_2 = ?$
 $T_2 = 121 + 273 = 394 \text{ K}$

(2)

$$5. \text{ ? mol } O_2 = 60.25 \text{ g KH} \times \frac{1 \text{ mol KH}}{40.02 \text{ g KH}} \times \frac{1 \text{ mol } O_2}{2 \text{ mol KH}} = 0.753 \text{ mol } O_2$$

$$K = 39.10$$

$$H = \frac{1.01}{40.02}$$

$$PV = nRT$$

$$V = \frac{nRT}{P} = \frac{(0.753 \text{ mol})(0.08205 \frac{\text{L-atm}}{\text{mol-K}})(25+273 \text{ K})}{1.00 \text{ atm}} = 18.4 \text{ B}$$

$$6. PV = nRT$$

$$n = \frac{PV}{RT} = \frac{(7.53 \text{ atm})(10.0 \text{ L})}{(0.08205 \frac{\text{L-atm}}{\text{mol-K}})(485 \text{ K})} = 1.89 \text{ mol}$$

$$\text{? molecules} = 1.89 \text{ mol} \times \frac{6.022 \times 10^{23} \text{ molecules } CO_2}{\text{mol } CO_2} = 1.14 \times 10^{24} \text{ molecules } CO_2 \text{ D}$$

$$7. \frac{V_1}{T_1} = \frac{V_2}{T_2}, \quad T_2 = \frac{V_2}{V_1} T_1 = \frac{135 \text{ mL}}{350 \text{ mL}} \times 28.298 \text{ K}$$

$$V_1 = 350. \text{ mL}$$

$$T_1 = 25 + 273 = 298 \text{ K}$$

$$V_2 = 135 \text{ mL}$$

$$T_2 = ?$$

$$T_2 = 115 \text{ K}$$

$$\text{or } 115 - 273$$

$$= -158^\circ \text{C} \quad \text{C}$$

$$8. P_{Ne} = P_T - P_{Ar}, \quad n_{Ar} = \frac{10.9}{39.95 \text{ g/mol}} = 0.250 \text{ mol Ar}$$

$$P_{Ar} = P_T \frac{n_{Ar}}{n_T} = 1.6 \text{ atm} \left(\frac{0.250}{0.746} \right)$$

$$n_{Ne} = \frac{10.09}{20.189 \text{ g/mol}} = 0.496 \text{ mol Ne}$$

$$n_T = 0.746$$

$$= 0.536 \text{ atm } 1.06 \text{ atm } \text{B}$$

9. $X_{He} = 1 - (0.47 + 0.23) = 0.30$

$P_{He} = X_{He} P_T = (0.30)(7.55 \text{ atm}) = 2.3 \text{ atm}$ E

10. $PV = nRT$

$n_{F_2} = \frac{PV}{RT} = \frac{(2.60 \text{ atm})(12.9 \text{ L})}{(0.08205 \frac{\text{L-atm}}{\text{mol-K}})(298 \text{ K})} = 1.37 \text{ mol } F_2$

? molecules $XeF_6 = 1.37 \text{ mol } F_2 \times \frac{1 \text{ mol } XeF_6}{3 \text{ mol } F_2} \times \frac{6.022 \times 10^{23} \text{ molecules } F_6}{1 \text{ mole } XeF_6}$
 $= 2.75 \times 10^{23} \text{ molecules } XeF_6$ D

11. ? g C_6H_6

? mL $C_6H_6 = 1.5 \times 10^3 \text{ kJ} \times \frac{2 \text{ mol } C_6H_6}{6278 \text{ kJ}} \times \frac{78.11 \text{ g } C_6H_6}{1 \text{ mol } C_6H_6} \times \frac{\text{mL}}{0.88 \text{ g}}$
 $= 42.4 \text{ mL } C_6H_6$ D

12. $\Delta E = w + q = -45 \text{ kJ} - 855 \text{ J} + -45 \text{ kJ}$
 $= -45.86 \text{ kJ}$ A

13. J/°C B

14. $q = mS \Delta T$
 $\Delta T = \frac{q}{mS}$, Smallest S yields greatest value for $\Delta T \rightarrow \text{Au B}$

15. $q = mS \Delta T$
 $-4.85 \text{ kJ} = (376 \text{ g})(0.128 \text{ J/g}^\circ\text{C}) \Delta T$
 $\Delta T = \frac{-4.85 \text{ kJ}}{(376 \text{ g})(0.128 \text{ J/g}^\circ\text{C})} = -100.8^\circ\text{C}$
 $T_f = \Delta T + T_i = -100.8 + 398 \text{ K} = 297 \text{ K}$ E

(4)

$$16. q_{\text{cal}} = C_{\text{cal}} \Delta T = -q_{\text{rxn}}$$

$$= (4.90 \text{ kJ/}^\circ\text{C})(29.00 - 25.00^\circ\text{C})$$

$$q_{\text{cal}} = 19.6, \quad q_{\text{rxn}} = -19.6 \text{ kJ}$$

$$\Delta E = \frac{-19.6 \text{ kJ}}{\text{mol sugar}} = \frac{-19.6 \text{ kJ}}{0.0102 \text{ mol}} = -1922 \text{ kJ}$$

$$\text{mol sugar} = \frac{3.50 \text{ g}}{342.3 \text{ g/mol}} = 0.0102 \text{ mol}$$

B

$$17. w = 0, \quad \Delta H \text{ \& } \Delta E \text{ are positive} \quad C$$

$$18. ? \text{ kJ} = 55.0 \text{ kg Fe}_3\text{O}_4 \times \frac{\text{mol Fe}_3\text{O}_4}{231.55 \text{ g Fe}_3\text{O}_4} \times \frac{1118 \text{ kJ}}{1 \text{ mol Fe}_3\text{O}_4}$$

$$= 26555.8 \text{ kJ or } 2.66 \times 10^5 \text{ kJ} \quad B$$

$$19. ? \text{ mol O}_2 = 100.0 \text{ g octane} \times \frac{1 \text{ mol octane}}{114.33 \text{ g octane}} \times \frac{25 \text{ mol O}_2}{2 \text{ mol octane}}$$

$$= 10.9 \text{ mol O}_2 \quad A$$

$$20. E$$

$$21. q_{\text{H}_2\text{O}} = m S \Delta T = -q_{\text{rxn}}$$

$$m = V_T \times 1.00 \text{ g/mL} = 200.0 \text{ mL} \times 1.00 \text{ g/mL} = 200.0 \text{ g}$$

$$q = (200.0 \text{ g})(4.184 \text{ J/g}^\circ\text{C})(37.00 - 35.00)$$

$$q = 1673.6 \text{ J}$$

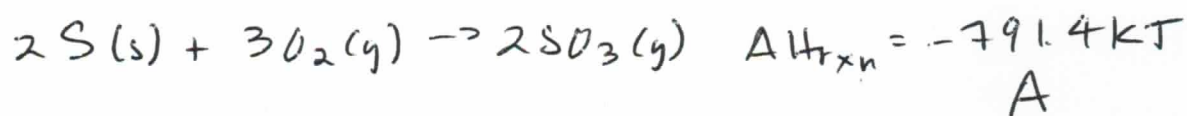
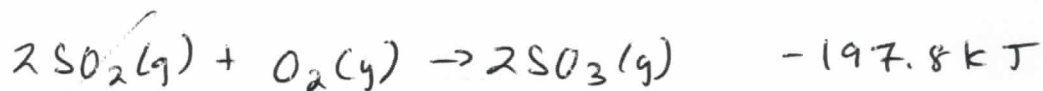
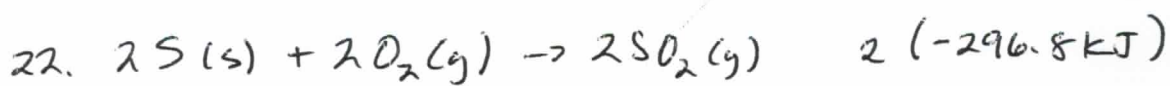
$$q_{\text{rxn}} = -1673.6 \text{ J}$$

$$\Delta H = \frac{q_{\text{rxn}}}{\text{mol NaOH}} = \frac{-1673.6 \text{ J}}{0.03} = -55.8 \text{ kJ/mol}$$

$$= -5.58 \times 10$$

$$\text{mol NaOH} = 0.300 \text{ mol/L} \times 0.1000 \text{ L} = 0.03$$

A



23. D Std. heats of formation involve formation from elements in natural state.

24. $\Delta H_{rxn}^\circ = [\Delta H_f^\circ CHCl_3(l) + 3\Delta H_f^\circ HCl] - [\Delta H_f^\circ CH_4 + 3\Delta H_f^\circ Cl_2]$
 $= [-134 + 3(-92)] - [-75]$
 $= -335 \text{ kJ} \quad C$

25. B system does work, w is neg., loses heat q is neg.

26. E more orderly structure in solid state

27. B more molecules of gaseous products than reactants

28. B endothermic process, ΔH_{sur} is neg.

29. A more structure in system, ΔS_{univ} is +

30. $\Delta G = \Delta H - T\Delta S$
 non at high T
 A

31. loses heat, ΔH is -, more orderly, ΔS is -
 D

32. $\Delta G = \Delta H - T\Delta S$

$0 = \Delta H - T\Delta S = -11000\text{J} + T(17.4\text{J/K})$

$\frac{\Delta H}{\Delta S} = T = \frac{-11,000\text{J}}{-0.0174\text{kJ/K}} = \frac{11,000\text{J}}{17.4\text{J/K}} = T$

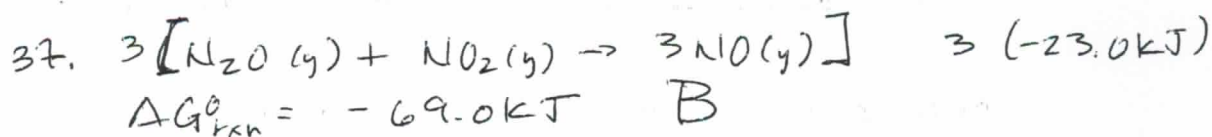
$T = 632\text{K} \quad \text{C}$

33. D molecules have greater entropy than atoms

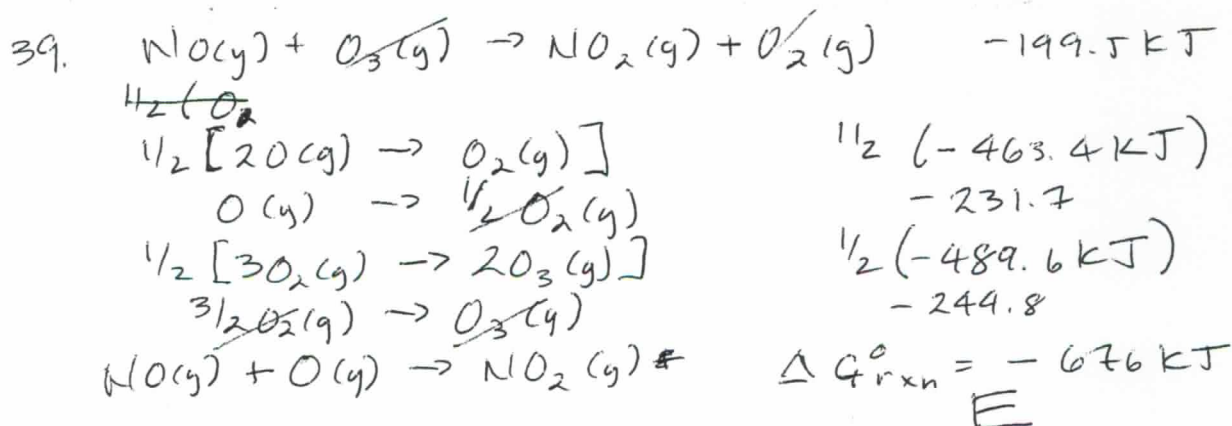
34. E larger molar mass elements have greater entropy

35. D larger ionic compounds have greater entropy when dissolved in water

36. $\Delta S^\circ_{\text{rxn}} = (229.2) - [200.9 + 2(130.7)]$
 $= 229.2 - 462.3$
 $= -233.1\text{J/K} \quad \text{D}$



38. Assume std conditions given ΔH° , ΔS° given,
 so $T = 25^\circ\text{C}$ or 298K
 $\Delta G^\circ = 179.2\text{kJ} - (298\text{K})(160.2\text{J/K})$
 $= 131.4\text{kJ} \quad \text{E}$



40. A reversible reaction achieves theoretical limit with respect to free energy